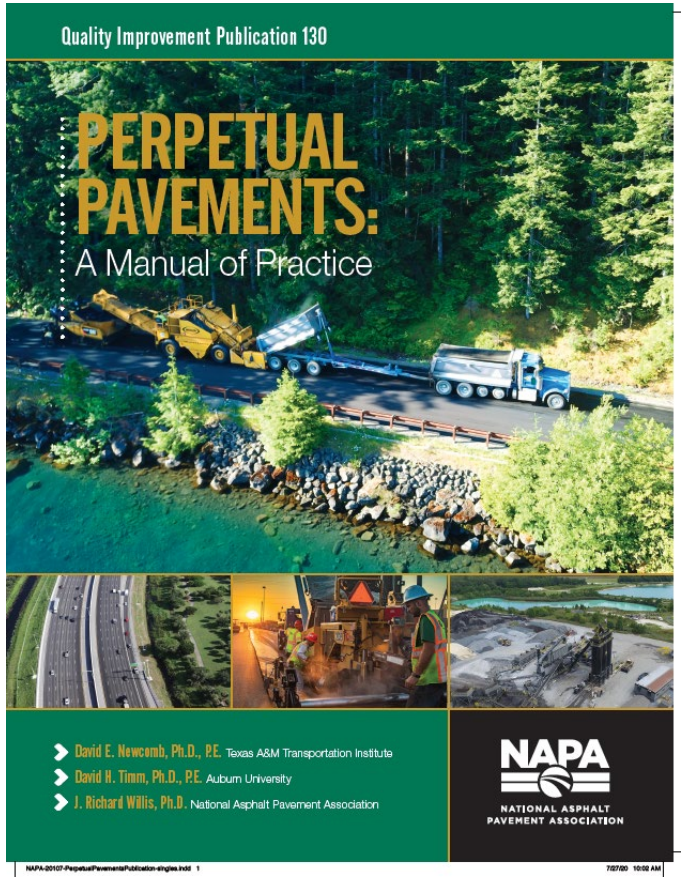
PERPETUAL PAVEMENTS
2022

DAVE NEWCOMB, SENIOR RESEARCH ENGR (RET)
TEXAS A&M TRANSPORTATION INSTITUTE

WISCONSIN ASPHALT PAVEMENT ASSOCIATION
ANNUAL MEETING

PERPETUAL PAVEMENTS: Manual of Practice



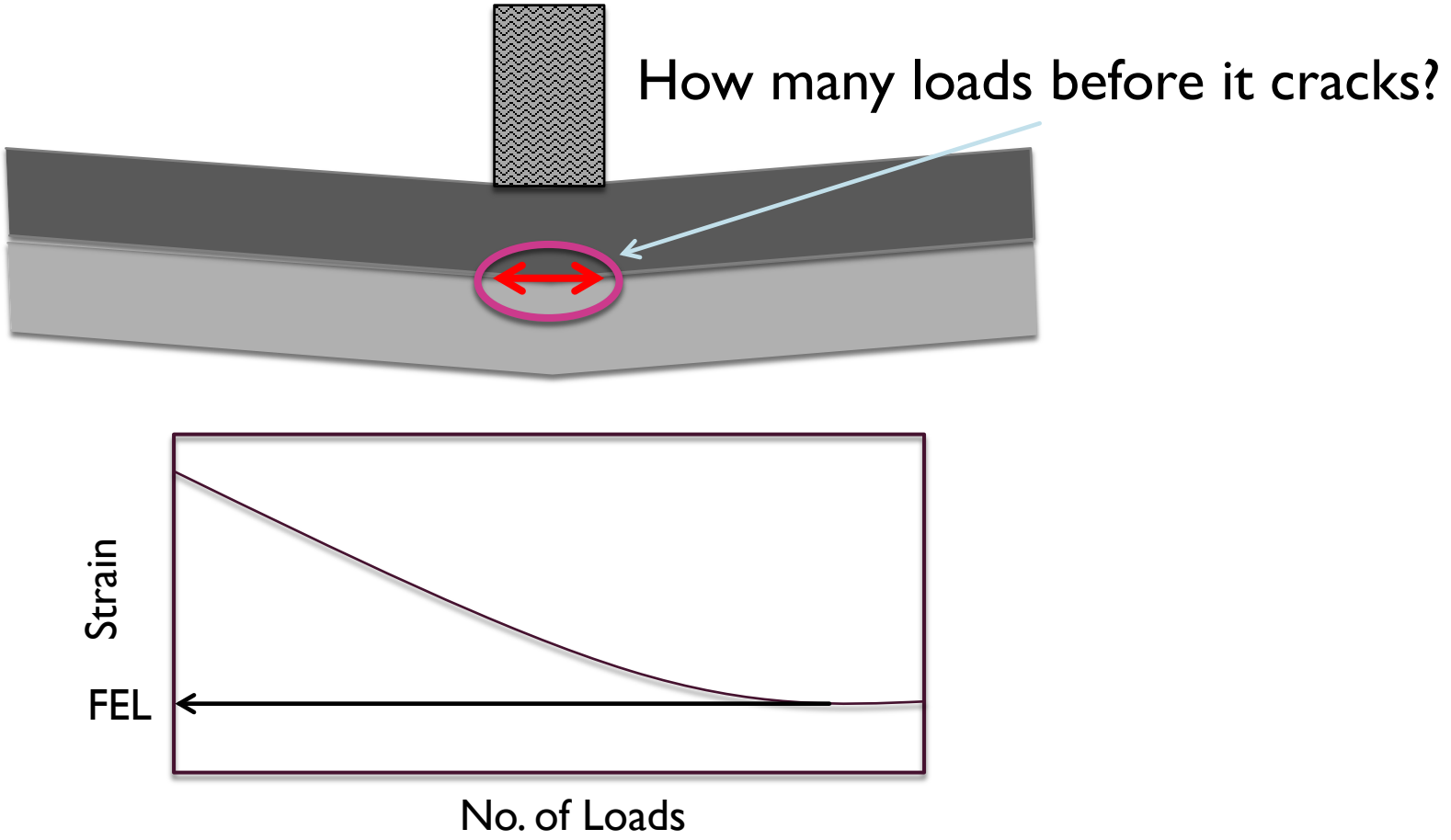
- Introduction
- Materials
- Structural Design
- Construction
- Concluding Thoughts
- www.asphaltroads.org

INTRODUCTION

INTRODUCTION

- Definition: Resist structural rehab for more than 50 years
  - Periodic surface renewal
  - Provide improved economy
  - Designed for heaviest loads
- Objectives of Manual
  - Provide guidance on materials and mix design
  - Discuss design methodologies
  - Show best practices for construction

The Key to Perpetual Pavements



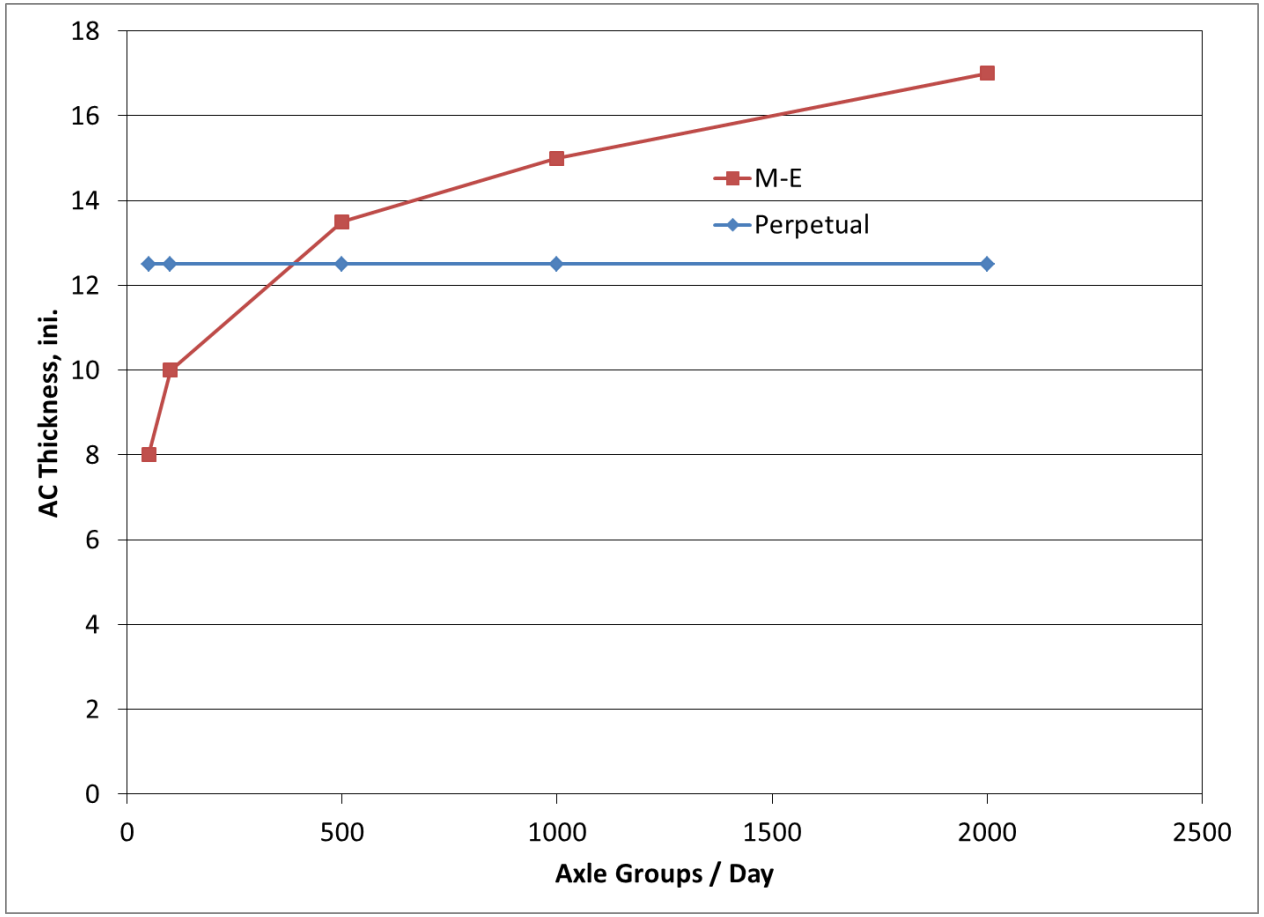
FATIGUE ENDURANCE LIMIT

- Originally set design at 70με.
- NCHRP 9-38: Lab value between 75 and 200
  - Polymer mixes have higher FEL
- Timm: design strain ratio

  SR = Field EL/Lab EL
  - Recommended SR = 2.45

MINNEAPOLIS – 6” 30 KSI BASE – 5 KSI SOIL

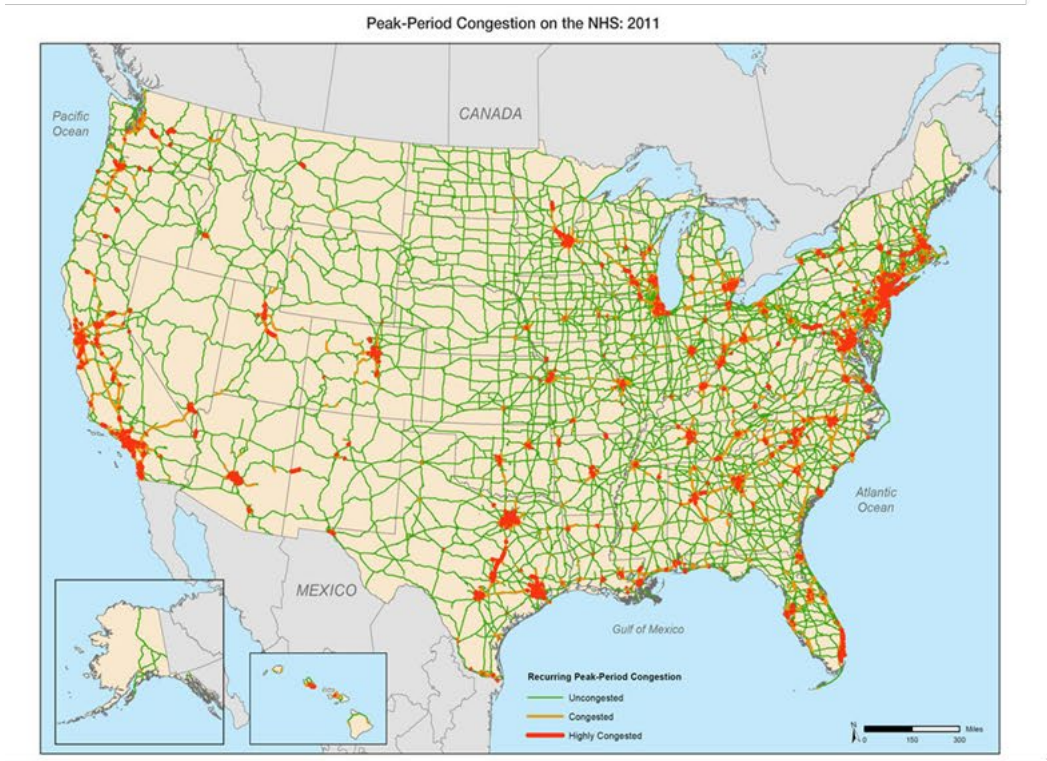
Each additional 1-inch of Asphalt Doubles the Fatigue Life! – Marshall Thompson



ECONOMY

- Eliminate reconstruction costs
- Reduce user delay costs during operation
- Conserve material resources
- Reduce energy consumption during operation
- Reduce life-cycle costs over the network

ECONOMY



(a) Year 2011.

(b) Year 2040.

MATERIALS

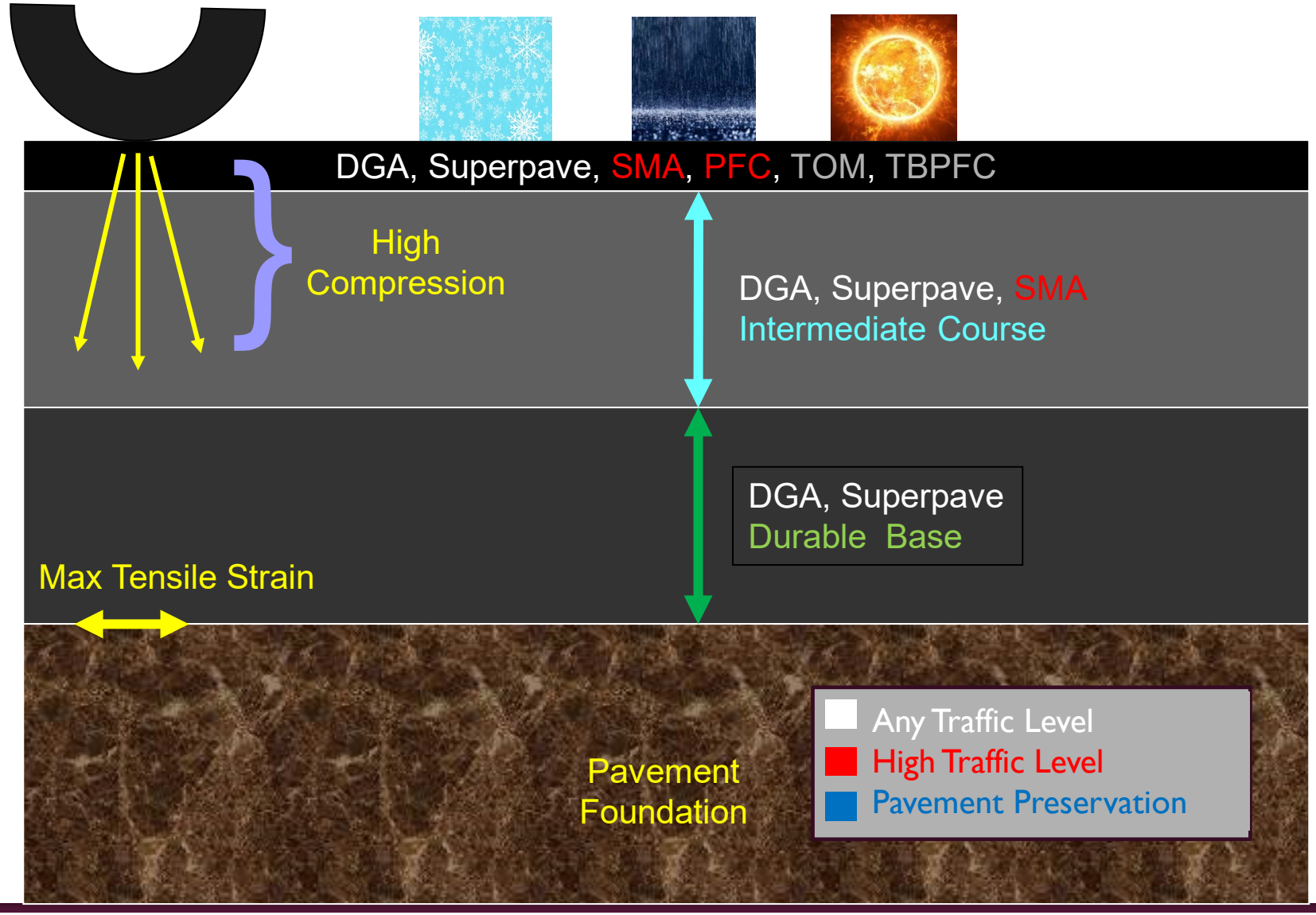
SOILS

MATERIALS

- Foundation
  - Not Much Change
  - Soils
  - Granular Materials
  - Stabilization
- Asphalt Materials and Mix Design
  - Base Layer
  - Intermediate Layer
  - Wearing Course

Working Platform

What Is Needed Where in a Pavement



FOUNDATION

- Very important layer!
- Provides working platform
  - Support equipment
  - Provide compaction resistance
  - Resistance to frost and swelling

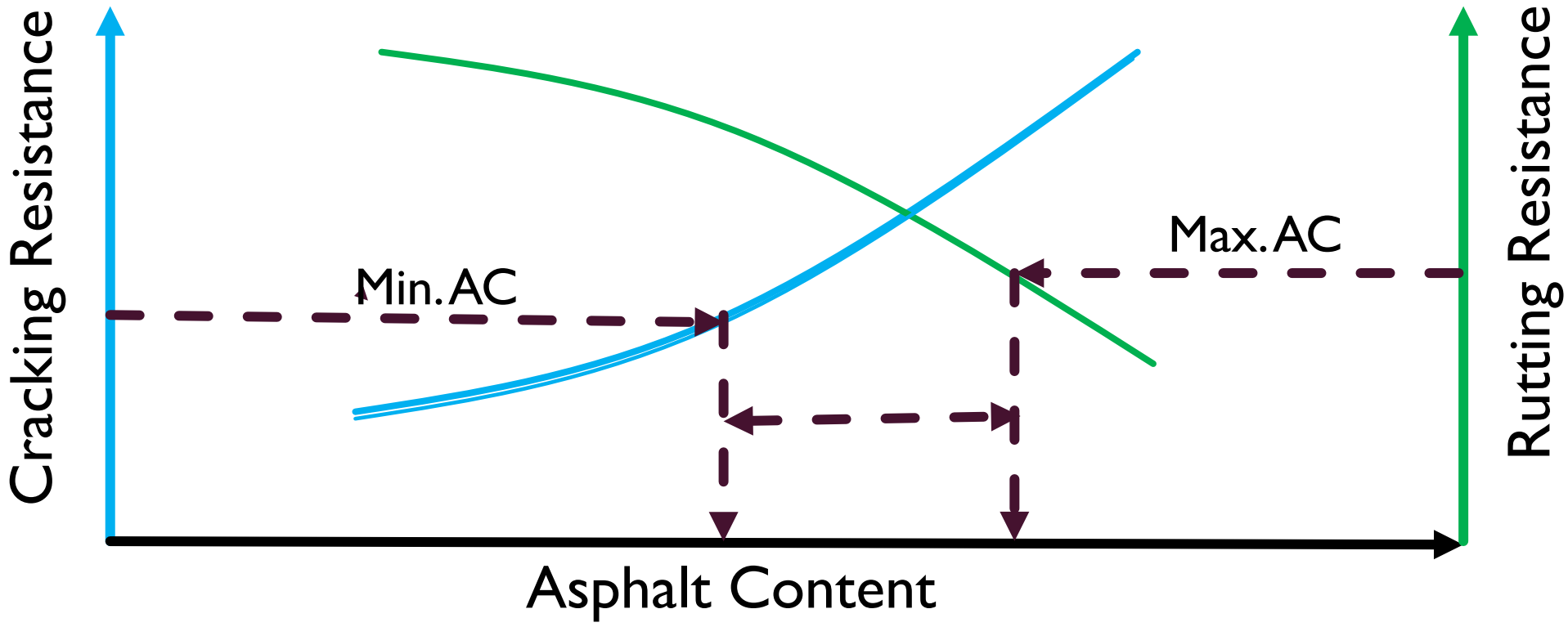
Functions of Asphalt Mixtures

- Durable, economical base layers
- Strong, rut resistant base and surface layers
- Smooth, safe, durable surfaces
- Permeable, high-friction, low splash and spray surfaces

ASPHALT MIXTURES

- Constructability – All layers
- Durability – All layers
- Fatigue Resistance – Lowest layer
- Rut Resistance – Upper/Intermediate layers
- Safety – Surface layer
- Noise Mitigation – Surface layer

BALANCED MIX DESIGN



Functions of Asphalt Mixtures

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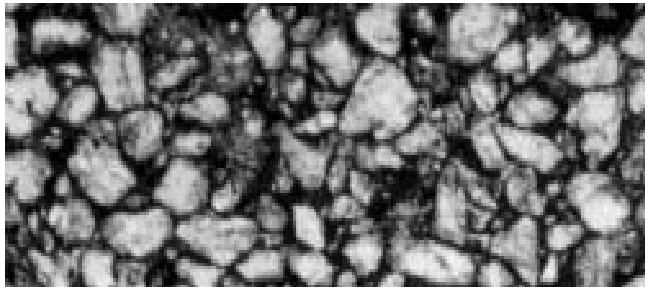
MIX TYPES FOR SURFACES

Dense-Graded Superpave

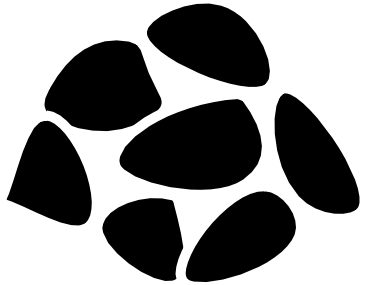
Gap-Graded SMA

Open-Graded OGFC

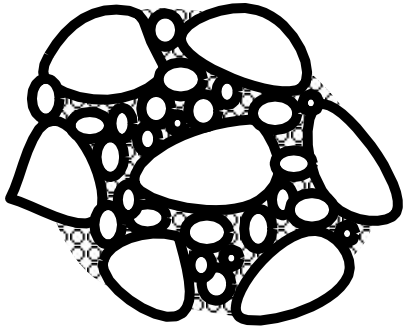


Types Of Gradations

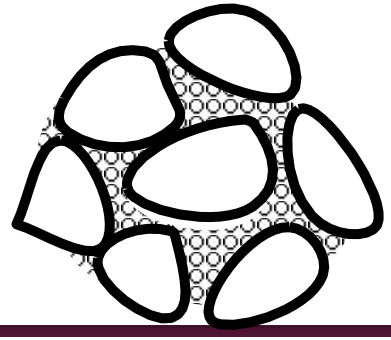
* Open graded
  - Few points of contact
  - Stone on Stone contact
  - High permeability

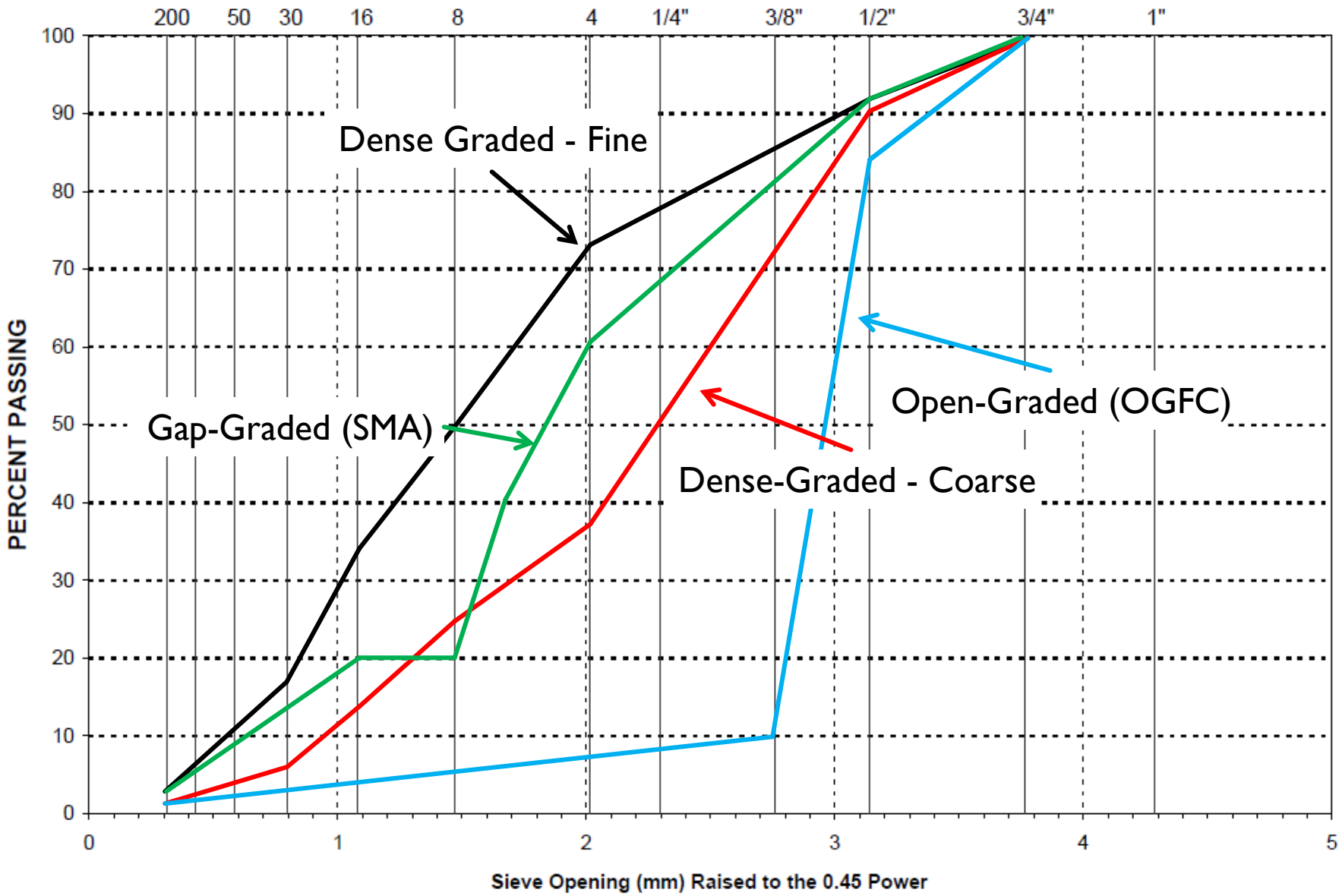


* Well graded
  - Good interlock
  - Low permeability



* Gap graded
  - Lacks intermediate sizes
  - Good interlock
  - Permeability varies




200
50
30
16
8
4
1/4"
3/8"
1/2"
3/4"
1"
100
90
80
70
60
50
40
30
20
10
0
PERCENT PASSING
Dense Graded - Fine
Gap-Graded (SMA)
Open-Graded (OGFC)
Dense-Graded - Coarse
0
1
2
3
4
5
Sieve Opening (mm) Raised to the 0.45 Power

SUPERPAVE

- Applications
  - Dense graded
  - High to low volume roads
  - Any pavement layer (surface, intermediate, base)
  - New construction and overlays
  - Aggregate quality depends upon layer and traffic

THIN OVERLAY MIX (TOM)

- Applications
  - High performance overlay mix
  - Thickness between ½” and 1 ¼”
  - Pavement preservation treatment
  - High to low volume roads
  - Applications requiring cracking resistance

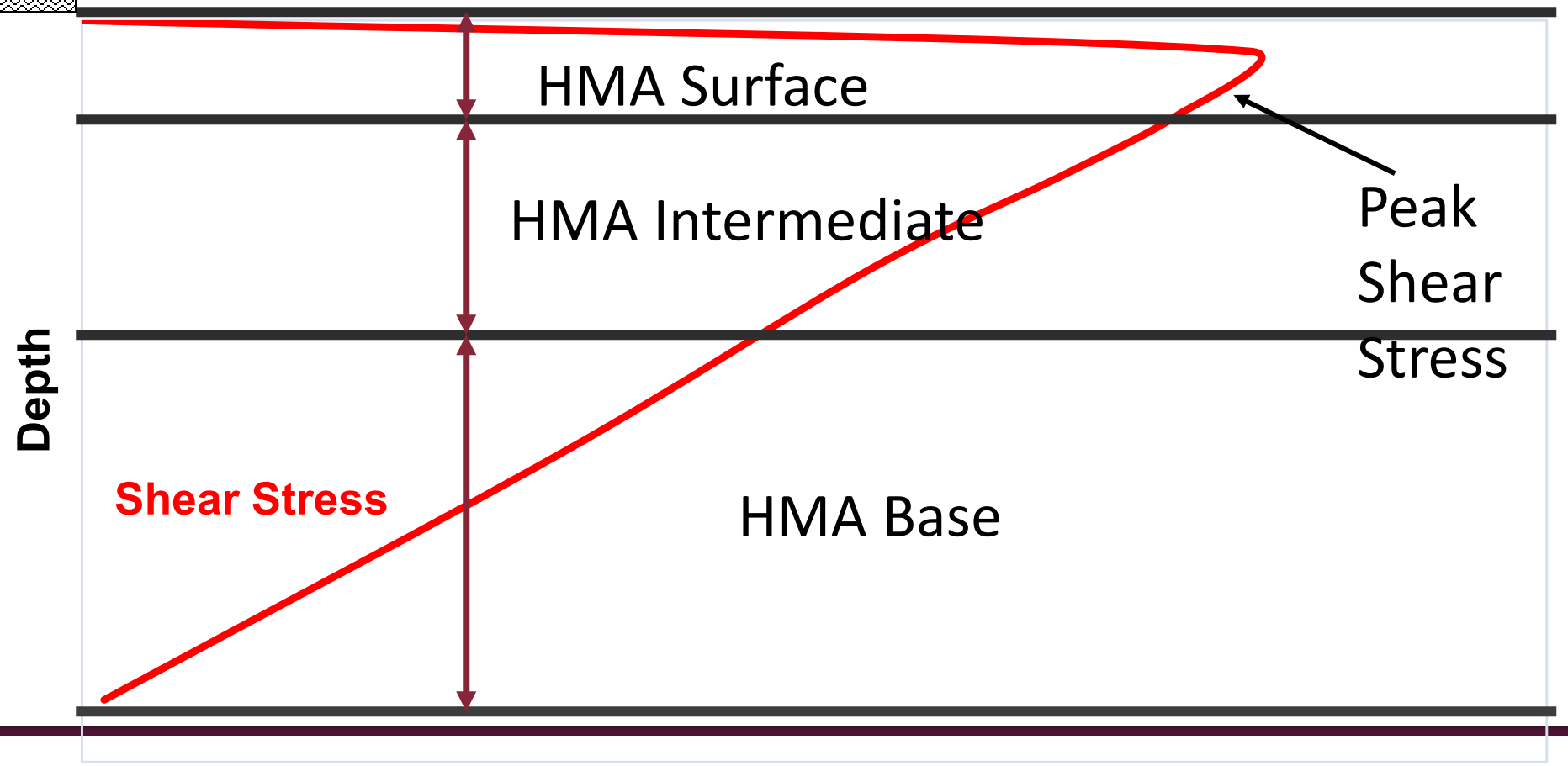
GOT JOINT SEALANT?

STRUCTURAL DESIGN

PERPETUAL PAVEMENTS

- Resist Structural Distresses
  - Fatigue Cracking
  - Rutting
- Withstand Climate and Traffic
  - Design for Subgrade Modulus
  - Use Strong Foundation
  - Mix Design
  - Materials Selection

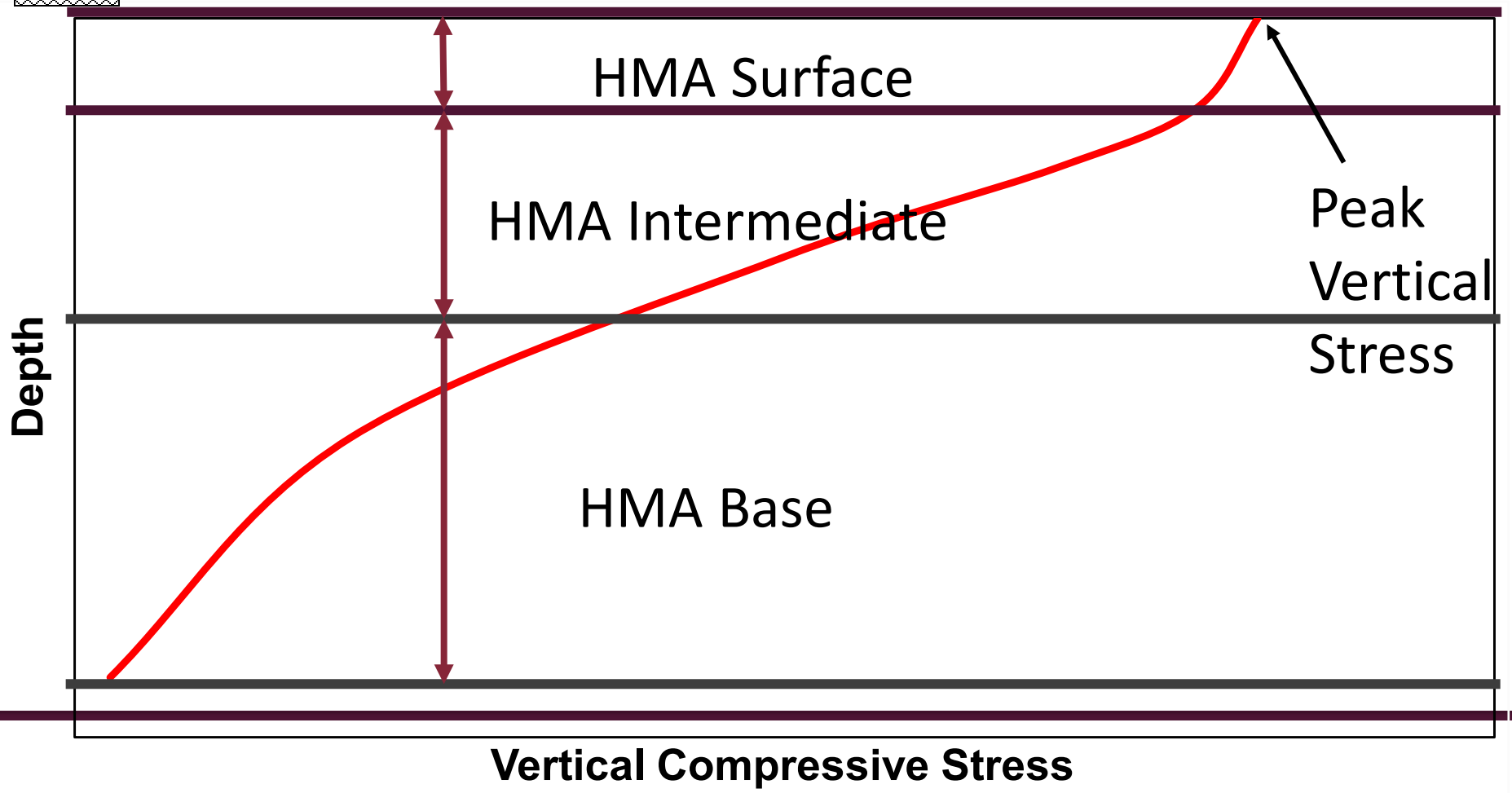
HORZ. SHEAR STRESS PROFILE



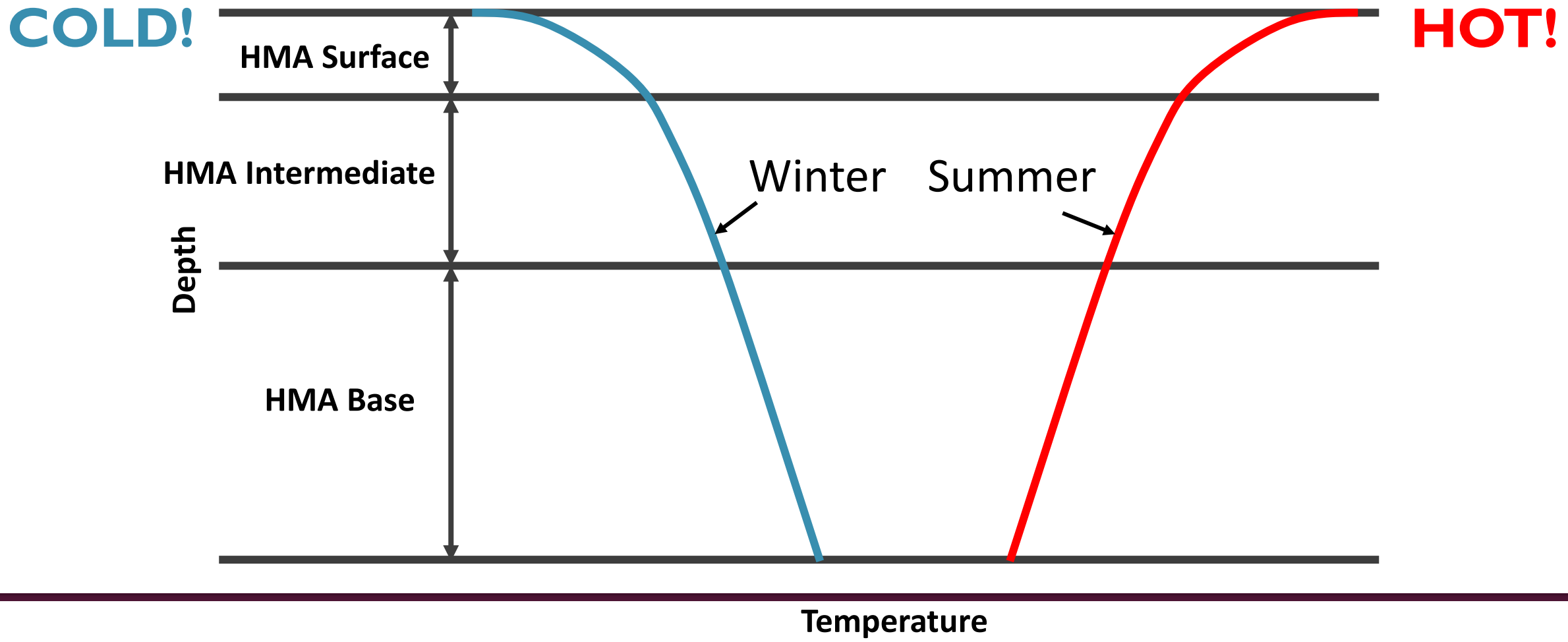
INTERLAYER BONDING

- Ensure complete tack coverage
- Use trackless or polymer modified or hot tack
- Keep traffic to a minimum

VERT. COMPRESSIVE STRESS



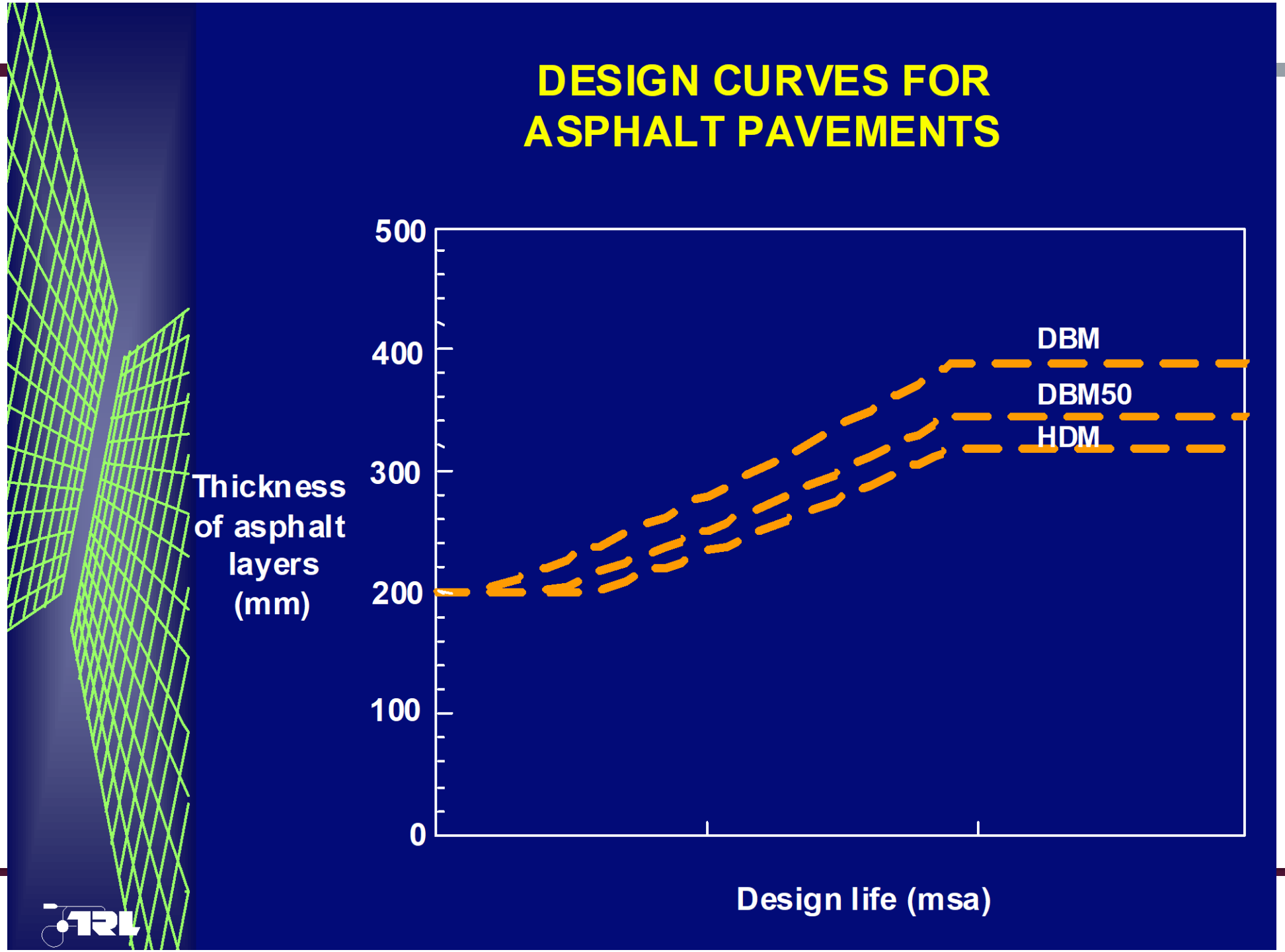
PAVEMENT TEMP. FLUCTUATION



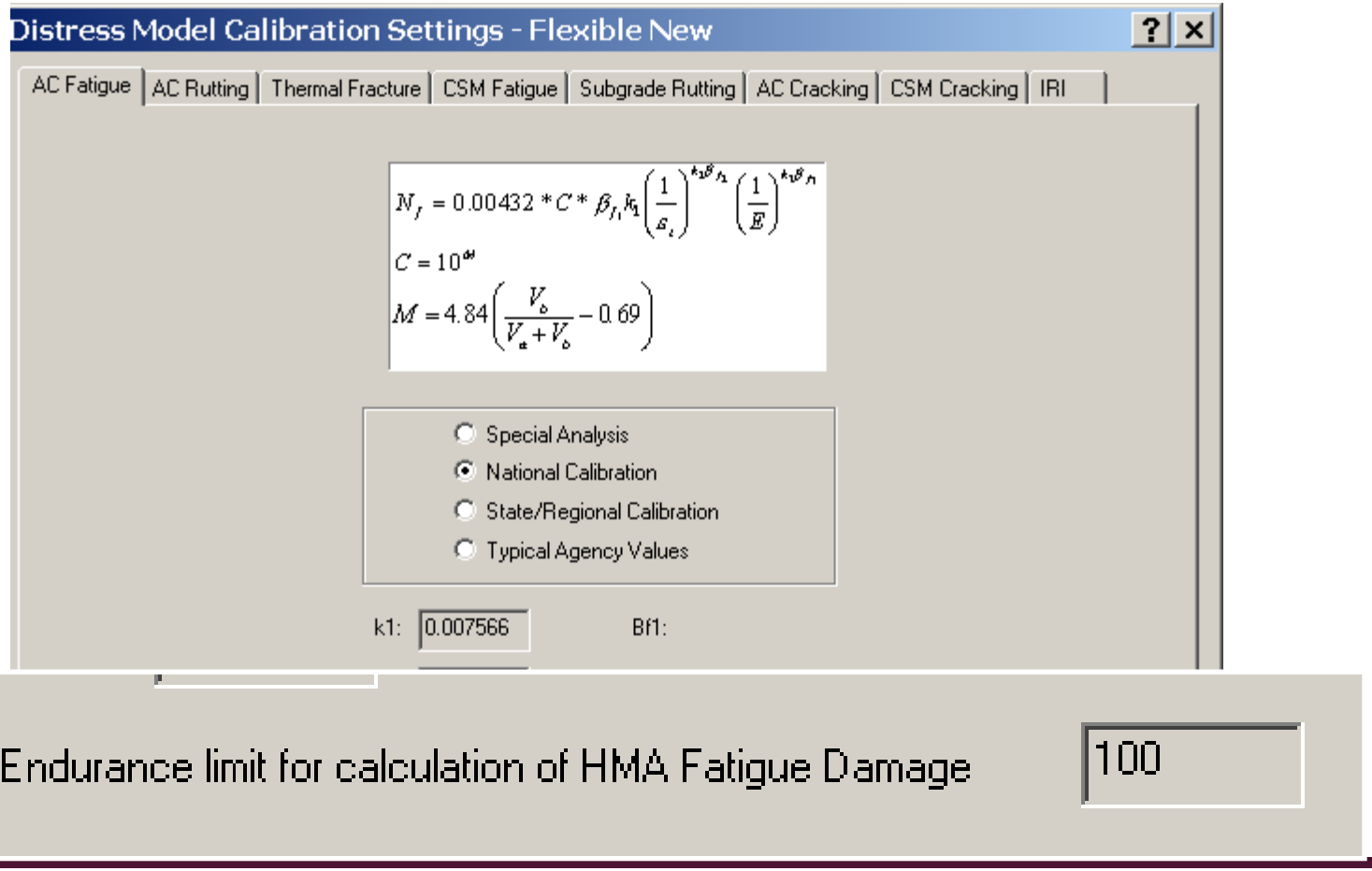
PERPETUAL PAVEMENT ADVANTAGES

- Efficient Design – No Overdesign
- Avoid Reconstruction
- Reduce Rehabilitation
- Reduce Life Cycle Cost
- Reduce Energy Consumption
- Reduce Materials Use

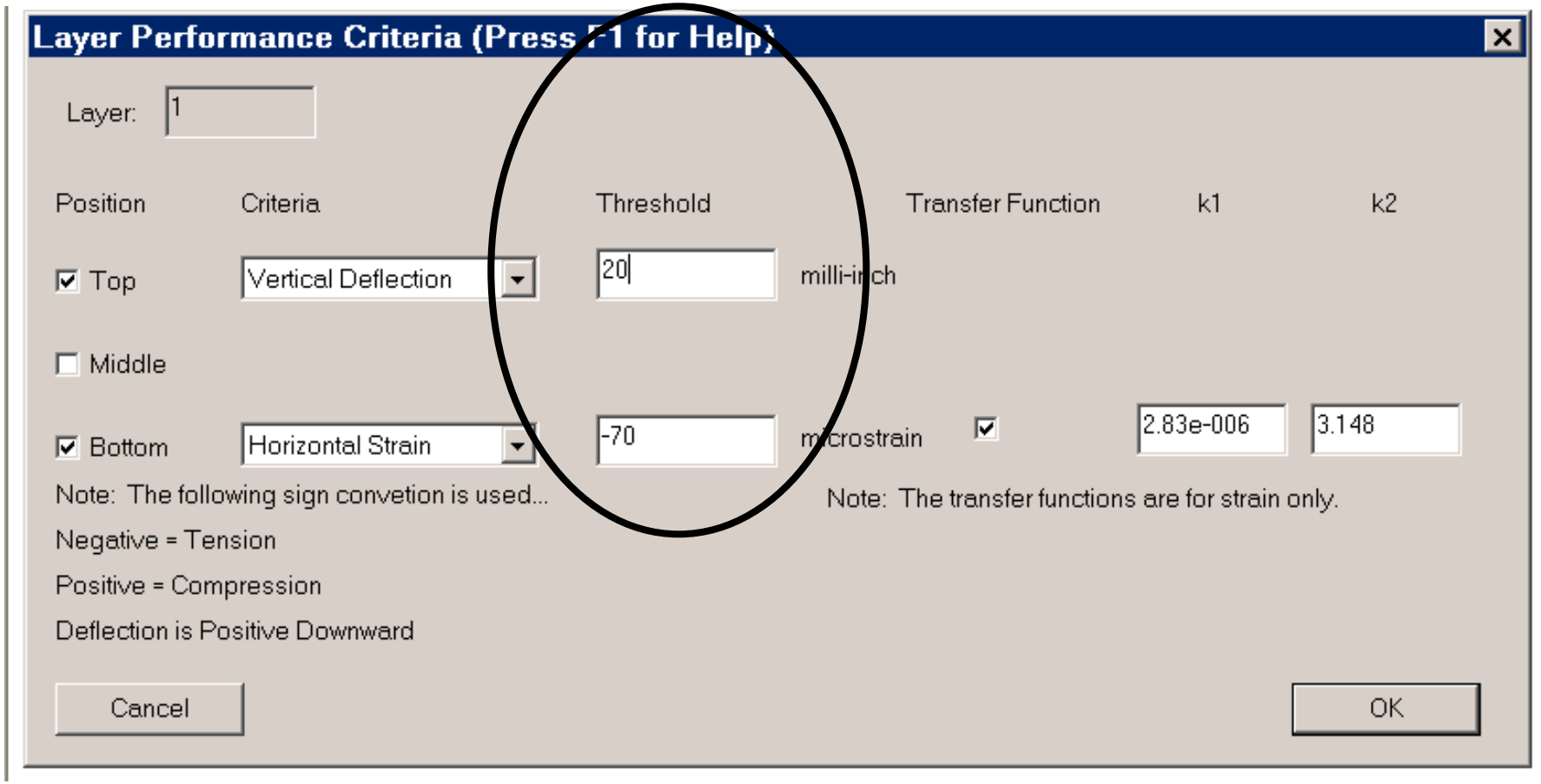
DESIGN CURVES FOR ASPHALT PAVEMENTS



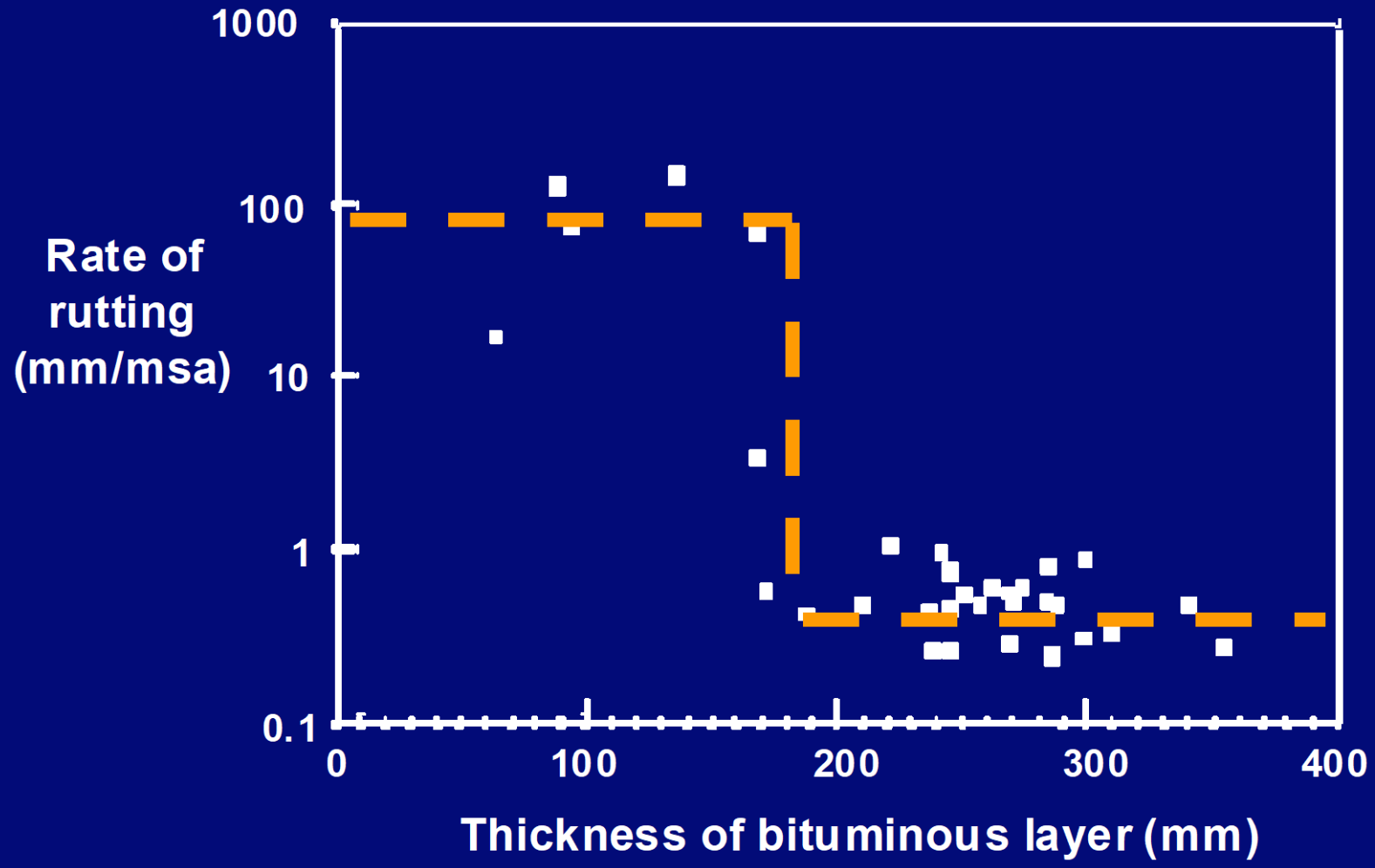
PAVEMENT M-E - FATIGUE CRACKING



PERROAD


Layer Performance Criteria (Press F1 for Help)
Layer: 1
Position
Criteria
Threshold
Transfer Function
k1
k2
Top
Vertical Deflection
20
milli-inch
Middle
Bottom
Horizontal Strain
-70
microstrain
2.83e-006
3.148
Note: The following sign convetion is used...
Negative = Tension
Positive = Compression
Deflection is Positive Downward
Note: The transfer functions are for strain only.
Cancel
OK

RATE OF RUTTING vs BOUND LAYER THICKNESS



CORE THROUGH CRACK

NEW JERSEY I-287 SURFACE CRACKING

DESIGN APPLICATIONS

- High Volume Pavements
  - MEPDG
  - PerRoad
  - TTI: FPS-21 (Tex-ME coming)
- Low and Medium Volume Pavements
  - PerRoad
- High Modulus Bases
- Pavement Rehab
  - Rubblization
  - Overlays

CONSTRUCTION

- Foundation requirements for construction
- Interlayer friction
- Density – especially in asphalt base layer
  - Avoid durability problems
- Overly stiff mixtures
  - Need crack resistance
- Segregation
- Joint density
- Asphalt layer bonding
- QC/QA

COMPACTION SUPPORT

Weak Support
Leads to Poor Compaction!

COMPACTION SUPPORT

Strong Support
Helps Compaction!

JOINT DENSITY

- Use fine-graded surface mix – Low permeability
- Construct and compact joint properly
- Use mastic

PERFORMANCE

- Perpetual Pavement Awards
- European Studies
- Oregon and Washington Studies
- New Jersey
- Connecticut
- Kansas
- Review of interstate performance
- Test sections

Want to know more about ASPHALT?

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AAPT OFFERS:

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- Annual Meeting & Proceedings
- Industry Contacts
- Timely Topics
  - Balanced Mix Design
  - Mechanistic Pavement Design
  - Asphalt Modification
  - Performance Testing for QC/QA
  - Many, many more!